

California Energy Commission

Five-Year Investment Plan, 2002 Through 2006
for the
Public Interest Energy Research (PIER) Program
Volume 1
Report to the California Legislature

(RD&D Committee Draft, February 9, 2001)

DISCLAIMER

This report was prepared for the California Energy Commission's RD&D Committee to be consistent with the requirements of AB 995 (Wright) and SB 1194 (Sher). It was accepted as the Committee's report on February 2, 2001. The report is scheduled for consideration and adoption by the full Commission on February 21, 2001. The views and recommendations contained herein are not the official position of the California Energy Commission until this report is adopted at a public meeting.

<http://www.energy.ca.gov/research>

Acknowledgments

Planning Team - Public Interest Energy Research Program

Alec Jenkins - Lead, PIER Program Planning and Evaluation

Mike Batham

John Beyer

Gary Klein

Mike Magaletti

Don Schwartz

Gerald Pine - GTI

Graduate Student Assistants

Jing Chen

Janine Flathmann

Natalia Golotvina

Student Assistant

Shannon Ryan

Contributors

Subject Area Leads and Staff - Public Interest Energy Research Program

Mike Batham – Environmentally-Preferred Advanced Generation

Kelly Birkinshaw – Environmental Research

Gina Barkalow

Nancy Jenkins – Buildings Energy Efficiency

Martha Brook

Pramod Kulkarni – Industrial, Agricultural, Water Efficiency

George Simons – Renewables

Laurie ten Hope – Strategic Research

General Counsel's Office

David Abelson

Energy Information & Analysis Division

Karen Griffin, Deputy Director (Acting)

Al Alvarado – Market Analysis and Modeling Unit

Energy Technology Development Division

Mike DeAngelis, Deputy Division Chief

Ron Kukulka, Assistant Deputy Director

PIER Program Manager

Terry Surles

RD&D Committee

Arthur H. Rosenfeld, Commissioner and Presiding Member

John Wilson, Principal Advisor

Robert A. Laurie, Commissioner and Associate Member

Scott Tomashefsky, Principal Advisor

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Introduction

The California Energy Commission (Commission) has prepared this report to present the Public Interest Energy Research (PIER) Program's strategic approach for addressing California's future energy needs. The strategies described below will lead to solutions—developed through research, development and demonstration (RD&D) projects—to increase electricity supply, reduce demand, lower peak demand, improve reliability and power quality, improve the operation of the market, and protect and enhance the environment.

This report responds to Assembly Bill (AB) 995 (Wright) and Senate Bill (SB) 1194 (Sher), signed into law in September 2000, which require that the Commission submit a Five-Year Investment Plan for the PIER Program to the Legislature by March 1, 2001. It also contains our response to important concerns raised by the PIER Independent Review Panel (IRP), convened in 1999 as directed by SB 90.

Since the original legislation establishing the PIER Program (AB 1890 in 1996 and SB 90 in 1997), significant changes have impacted California's energy landscape. The PIER Program's strategic approach will help to alleviate or avoid California's energy problems, such as those impacting the state today in this new, dynamic energy environment.

This report is organized into the following sections:

- Vision and Mission
- Public Benefits Criteria and an Operational Definition of Public Interest Energy Research
- The California Energy Context
- California's Energy Problems and the PIER Program's Solutions
- Five-Year Plan Implementation: Funding Allocations
- Five-Year Plan Implementation: Recommendations of the Independent Review Panel
- Summary

More detail is presented in the companion document, *Supplement to the Five-Year Investment Plan, 2002 Through 2006, for the Public Interest Energy Research (PIER) Program, Report to the California Legislature* (<http://www.energy.ca.gov/research>).

Vision and Mission

In the future, California must provide a clean, affordable, reliable, and resilient supply of electricity where “smart,” efficient customers have energy choices that can meet their individual needs, and California's industries can grow and prosper. The PIER Program will support and catalyze science and technology advancements by providing leveraged funding to establish California as the world leader in energy efficiency and clean, advanced energy technologies and systems.

The mission of the PIER Program is to conduct public interest energy research that seeks to improve the quality of life for California citizens by developing environmentally sound, safe, reliable, and affordable electricity services and products. Public interest energy research includes the full range of RD&D activities that advance science and technology not adequately provided by competitive and regulated markets.

Public Benefits Criteria and an Operational Definition of Public Interest Energy Research

This section responds to the AB 995 and SB 1194 requirement that: “The initial investment plan shall include criteria that will be used to determine that a project provides public benefits to California that are not adequately provided by competitive and regulated markets.”

In addition to public benefits criteria, this section responds to comments in the March 2000 report of the PIER Independent Review Panel that the Commission had not adequately provided an operational definition of what constitutes public interest RD&D. The term public interest RD&D is rooted in two State acts, AB 1890 and SB 90, which authorize the PIER Program. Note that the terms “public interest” and “public benefits” are not interchangeable. “Public interest” includes the provision of “public benefits” as described in this section.

Much discussion of these topics has occurred during the past several years, and it is widely recognized that no bright lines mark the boundaries between public interest RD&D activities and other activities such as competitive and regulated RD&D or commercialization activities. A project often has both public and private benefits. Projects have net societal benefits when the benefits provided exceed the public costs.

AB 1890 and SB 90 set forth the four cornerstone criteria to define public interest energy RD&D activities by specifically requiring that the PIER Program fund only (1) “*research, development and demonstration* [efforts that] advance science or technology; (2) *not adequately provided* by competitive and regulated markets; (3) [that] *provide in-state benefits* ... of value to California citizens; and (4) [*that are in the energy-related subject areas* of] environmental enhancements, end-use efficiency, environmentally-preferred advanced generation technologies, renewable technologies, and other strategic energy research ...” (emphasis added, Public Utilities Code Section 381 and Public Resources Code Sections 25620 and 25620.1).

The PIER Program relies on these criteria in the operational definition of public interest RD&D. To provide consistency, these criteria and the related questions below are applied where appropriate to program planning, project selection, and evaluation activities.

- *Is the project or activity considered research, development or demonstration?*
 - Does it create new knowledge, is it an application of new knowledge, or is it an application new to the market?
 - Does it advance science or technology?
 - Does it address any key technical or scientific barrier?
- *Do competitive and regulated markets provide adequate funding for the project or activity?*
 - Is there inadequate funding and why?
 - Is there unreasonable duplication of effort?

- *Will the project or activity produce benefits for California?*
 - Will it contribute to one or more of the five public benefit energy objectives?
 - Improve energy cost/value
 - Improve the environment, public health and safety
 - Improve reliability/quality/sufficiency
 - Strengthen the economy
 - Provide consumer choice
 - Do anticipated California benefits exceed costs?
 - Is the research adequately connected to the market?
- *Does the project or activity address priority energy issues or problems?*
 - Is the project or activity consistent with the Five-Year Investment Plan's priorities?
 - Are the research strategies of the projects consistent with the strategies identified in the investment plan?
 - If the research strategies are not consistent with the Investment Plan, is there a compelling case why the strategy or activity is appropriate and will satisfy the other public interest criteria?

The California Energy Context

California is currently experiencing significant problems and uncertainty regarding its recently restructured electricity market. The vision of an increasingly clean, affordable, and reliable electricity system has not been met.

The advancement of science and technology through the PIER Program can provide lasting technological solutions to mitigate these and other energy problems, particularly if the research is directed at meeting California's specific needs. Establishing the California energy context for the PIER Program was a major recommendation of the Independent Review Panel.

California is faced with many energy-related challenges from circumstances and trends that include demographics, technological advances, economic conditions, social values, political factors, and climate and environment. While many of the challenges are not unique to this state alone, they are exacerbated by California's size, projected population growth (approximately 15 percent from 2000 to 2010), and a higher standard of living fueled by high technology industries. Areas of concern facing both California and other parts of the nation include the following:

- Increased reliance on a single fuel, natural gas
- Need to improve demand side management processes and end-use energy efficiency
- Use of older, less efficient central generating facilities and transmission systems
- Financial and investment constraints and competition
- Uncertainties associated with global climate change impacts and policy initiatives
- Continuing local opposition to the siting of large generating facilities.

In addition to these common concerns, California faces challenges caused by circumstances and trends that are unique or amplified by California's characteristics, and have recently become highly visible. This dynamic, new environment is an opportunity to observe where the challenges and weaknesses are presently showing up in an electricity system under stress, and to note where these can be relieved through well-targeted advances in science and technology. Through this approach, PIER will identify and provide more permanent solutions to achieve the better electricity system of tomorrow.

In the following outline of the context for planning the PIER strategies, we look at the circumstances of a system under stress.

Demographics

California's population growth is occurring predominantly in hotter inland areas (**Figure 1**), resulting in increasing electricity demand for air conditioning. As a result, per capita energy use is expected to increase. This could be exacerbated by an increase in telecommuting because more people will be at home during the day.

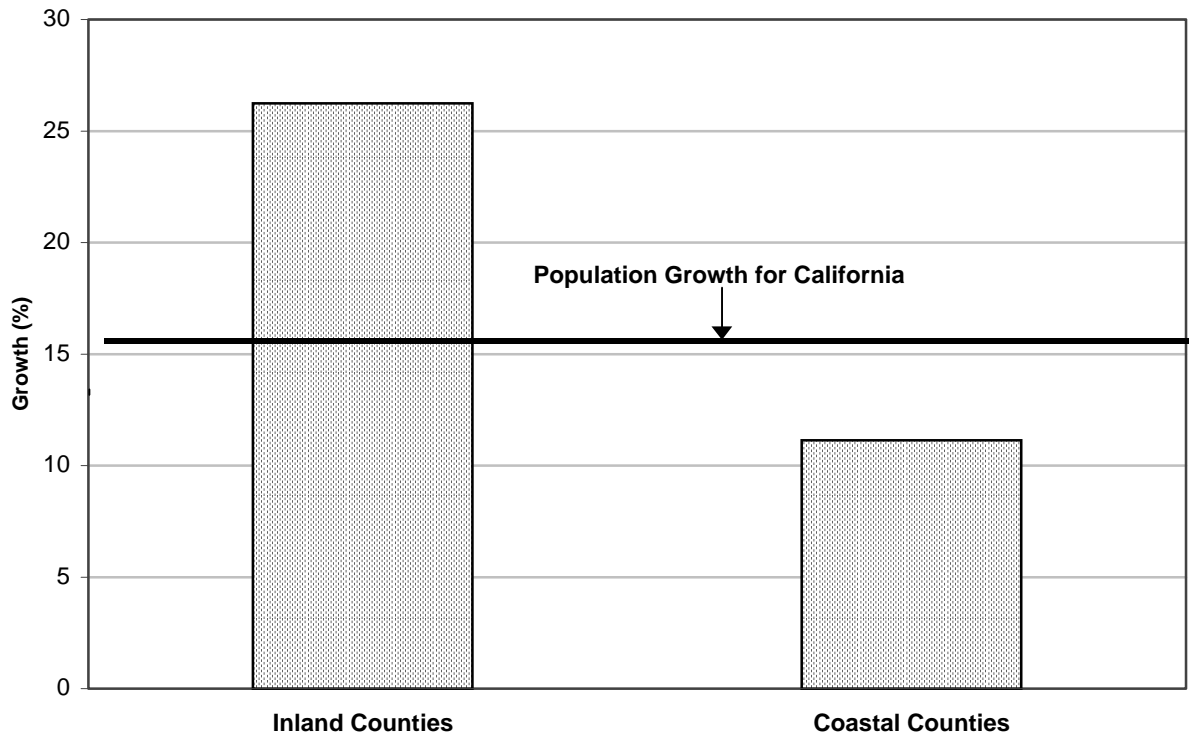


Figure 1. Projected Population Growth 2000-2010

Note: The growth was computed as the weighted average of growth of counties whose population is greater than one percent of the total state population.

Source: State of California, Department of Finance, *County Population Projections with Race/Ethnic Detail*. Sacramento, California, December 1998.

High Technology Sector

California leads the world in electronics, computer systems, software development, and information technology and is home to international leaders in biotechnology, analytical instrumentation, and sensor development. The continued growth of the high technology sector, critical to the state's economic well being, demands a resilient electricity system that provides reliable and high quality power. In Silicon Valley counties, major increases in electricity demand are projected to be driven primarily by the rapidly growing high technology industry. For example, requests for new electricity capacity in the City of Santa Clara are predominantly for Internet data centers, as shown in **Figure 2**.

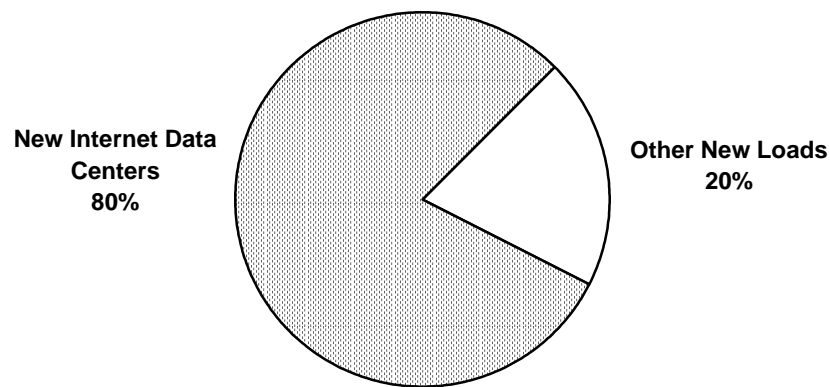


Figure 2. Internet Load Growth – City of Santa Clara, Requests for New Capacity Additions 2001- 2003

Note: The City of Santa Clara currently has 450 MW of peak generation capacity. It is likely to need 150 MW of new peak capacity, with a potential need for 425 MW. The percentages are applicable over the range.

Source: Silicon Valley Power, City of Santa Clara. Telecommunications 1/17/01-1/18/01.

Social Values

Californians' social values are part of the reason that the state is a world leader in developing and using "green" technologies and cutting-edge environmental solutions. California's buildings and appliance standards are hallmarks. Continuous improvements in end-use technologies to reduce capital cost and improve operational characteristics will provide California customers with additional options to meet those standards.

California has been a leader in diversifying its suite of clean generation technologies, with a growing demand for "green" power. However, the current increased reliance on natural gas reduces this diversity. Coupled with California's location within the national gas distribution system, this has made the state vulnerable to fuel supply shortages and increased price volatility (**Figure 3**).

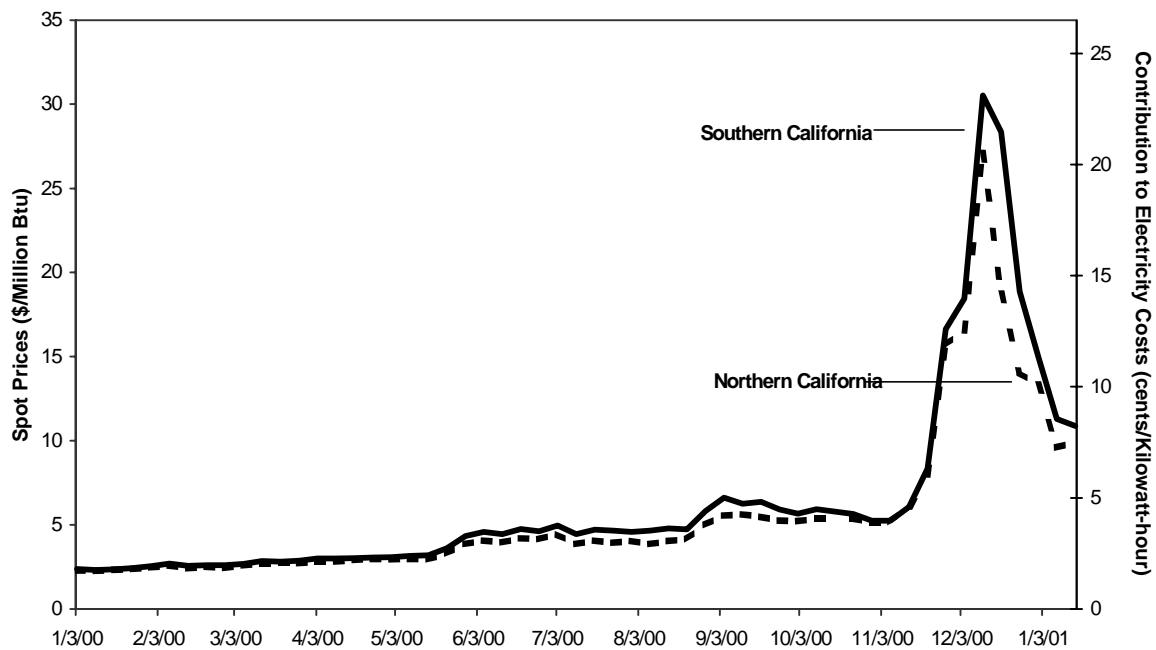


Figure 3. Contribution of the Price of Natural Gas to the Cost of Fossil Generation, January 2000 – January 2001

Source: NGI Intelligence Press, Inc., *NGI's Weekly Gas Price Index*,
<<http://www.intelligencepress.com>>.

Air Quality

California's air quality regulations for mobile sources drive change within the transportation sector. As the seventh largest economy in the world, the state has catalyzed innovation in the automobile industry. While current air quality regulations for stationary sources related to emissions offsets and nitrogen oxides allowances may inhibit generation now (**Figure 4**), in the future these high emissions costs could encourage the use of renewables, fuel cells, and other advanced generation technologies with very low emissions.

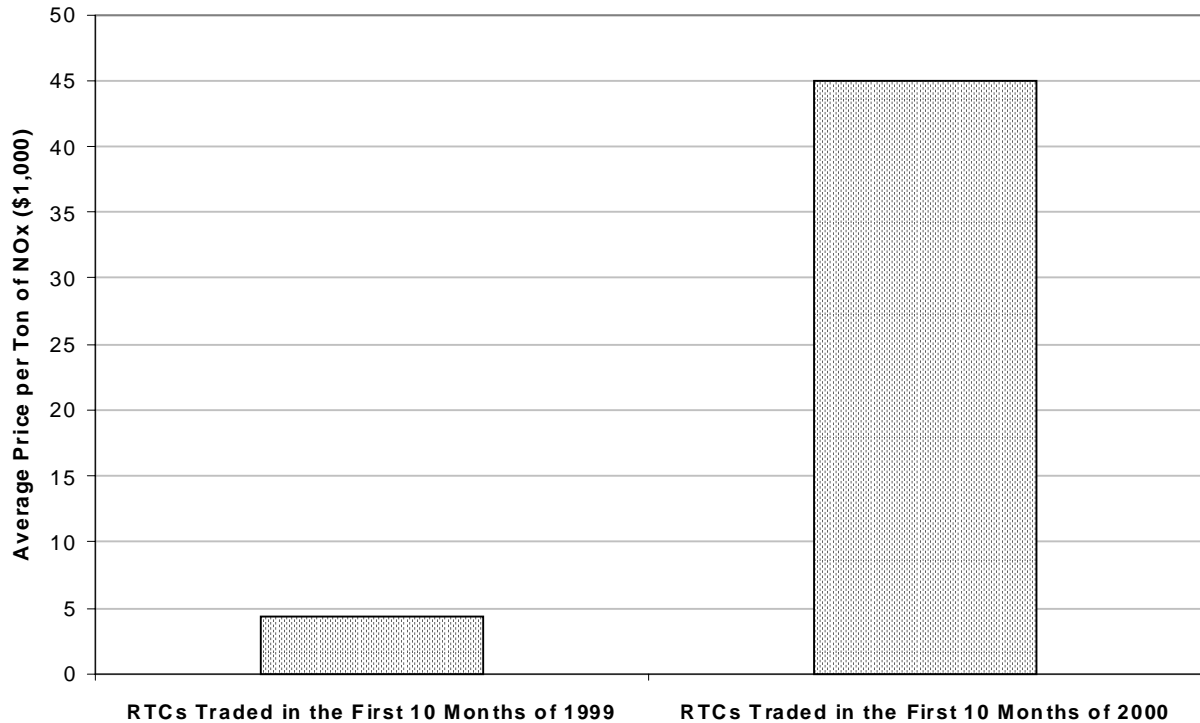


Figure 4. South Coast Air Quality Management District: Average Price of NOx RECLAIM Trading Credits (RTC)

Source: South Coast Air Quality Management District, White Paper on Stabilization of NOx RTC Prices, January 11, 2001, pages 1-5.

Water

Water quality is important both for public health and viable aquatic ecosystems. The availability of clean hydroelectric power, as well as the implementation of innovations in low head hydro technology, requires an abundant supply of water. But yearly rainfall and snow pack variability in California result in hydroelectric generation that can vary by a factor greater than 2:1 (**Figure 5**). And hydropower is particularly important as a resource relied upon primarily during summer peak load periods.

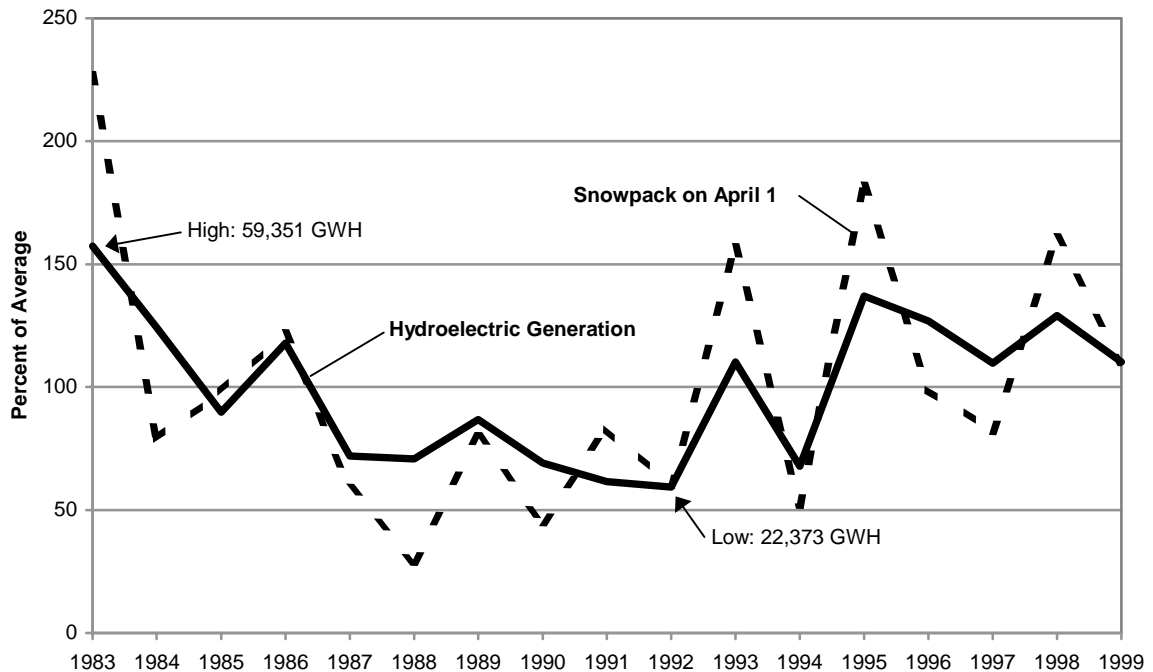


Figure 5. Variation of Hydro Power and Snowpack in California

Source: Hydropower data are from the California Energy Commission.
Snowpack data are from the California Department of Water Resources Web site, <<http://cdec.water.ca.gov/cgi-progs>>.

Global Climate Change

Changing climatic conditions could also exacerbate future water and power availability. Continued and growing reliance on fossil fuels will increase emissions of carbon dioxide and nitrogen oxides, resulting in further global warming. It is uncertain how temperatures in California would be affected and how a changing climate will affect the frequency and intensity of storm events in the state. A Commission study indicates that a 3°C rise in temperature, with no change in precipitation, would reduce the California snow pack available for electricity generation by 52 percent.

Increased winter rains, instead of snow, would exacerbate the uncertainty of hydroelectric power supplies because it would necessitate releasing additional water from reservoirs during the winter for flood protection, making the water unavailable for power production during periods of high demand over the summer. And by increasing the temperature, climatic change will increase air conditioning loads during the summer peak. It could also necessitate changes in institutional requirements (emissions controls, carbon tax, etc.), which would impact the relative economic benefits of technology choices.

Other Factors

Other California-specific factors that must be addressed in PIER planning include the following:

- Seismic vulnerability and protection of critical public infrastructure, and
- Growing peak loads, including needle peaks that drive prices up while straining the reliability and power quality of the system.

Finally, as part of the California context, there is a challenge for PIER to take advantage of California's unique combination of business, research, and government resources. California possesses world-class intellectual and institutional resources to assist the state in meeting these challenges. The University of California system is a resource for excellent science and technology, as well as being the contractor for three U.S. Department of Energy national laboratories.

The state is a world leader in electronics, computational systems, software development, and information technology. The state also is home to international leaders in biotechnology, analytical instrumentation, and sensor development. As a world economic leader, state and local governments have supported and incubated new ideas and technologies. And, despite the current state energy situation, the state government was far-sighted in establishing a well-funded energy RD&D program at the onset of deregulation. The following sections will focus on problems and solutions, but many resources are available in California to attack and solve our energy problems.

California's Energy Problems and the PIER Program's Solutions

From the circumstances and trends comprising the California energy context, the Commission has grouped California's energy problems into four broad headings.

1. Electricity demand has been increasing faster than supply

This problem has become alarmingly obvious in recent months.

When electricity restructuring was first discussed in the early 1990s, California had an adequate reserve of generating capacity. Now this adequate capacity reserve no longer exists. Over the past decade, nearly 4,000 MW of additional generation has come on line in California (1,500 MW requiring Commission approval), and some older units have been retired. Recently, nine new generating units have received Commission permits, and many more new units have applied. However, the generation additions have occurred over a period when peak demand has risen sharply (**Figure 6**), and market dynamics and other factors have restricted effective supply, driving up energy prices.

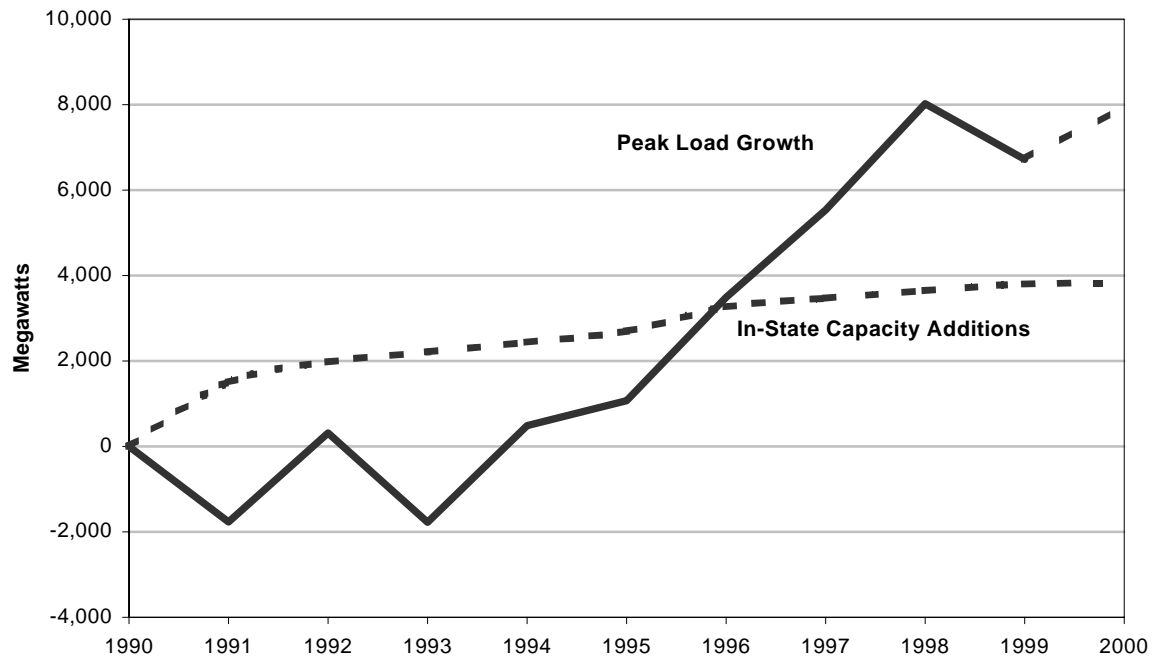


Figure 6. California Cumulative In-State Electric Capacity Additions vs. Peak Load Growth 1990-1999

Note: California typically relies on imports for about 20 percent of its annual electric energy requirements and for about 10 percent of its electrical capacity.

Sources: *California Energy Demand: 2000-2010*, P200-00-002, June 2000. *California Energy Commission Power Plant Database*, June 22, 2000. *Summer of 2001 Forecasted Electricity Demand and Supplies*, P300-00-006, November 2000.

Until recently, because of low energy prices and institutional barriers to new technology introduction, there has been little concerted effort to develop better demand side management practices and technologies or new distributed generation and renewable technologies. Failure to address the problem of demand increasing faster than supply will lead to significantly greater increases in electricity costs than the billions of dollars experienced today.

The PIER Program will address this problem by funding RD&D aimed at:

- *Increasing supply* - PIER will fund the development and implementation of renewable and small-scale fossil fuel generation facilities that have the potential to substantially add to California's electricity supply. These small-scale facilities can be sited near customer load centers. This effort will include environmental research and assessment programs to ensure that adverse impacts are not overlooked.
- *Reducing demand* - PIER will support the development of technologies and systems to improve the efficiency of operations, such as cooling and lighting in existing buildings, and the development of technologies and strategies to improve the energy efficient design, construction, and operation of new buildings. PIER will also support the development of more efficient processes and technologies for industry, agriculture, water pumping, and water and waste treatment. These and other PIER efforts will be enhanced by efforts, such as technology incubators, to improve the market use of PIER advanced systems.
- *Developing better information and decision-making tools* - PIER will fund the development of advanced sensors, models, and systems for real-time feedback and control of electricity usage. These systems will couple information on use, performance, and pricing to minimize cost while optimizing energy use.

2. Rising peak demand threatens reliability and power quality

Rising peak demand for electricity, including the growth of needle peaks, results in higher and more volatile electricity prices, as well as increasing the potential for costly interruptions in service. By 2010, peak electricity demand in California is expected to grow by 18 percent.

High peak demand could prove to be a serious and enduring threat to the state economy. Transmission and distribution system throughput approaches maximum capacity during peak demand periods, threatening reliability and power quality. The failure in recent years to expand transmission and distribution systems has resulted in serious congestion problems. System reliability is further strained by the current system of market transactions among generators, operators, utilities, and customers. These factors have contributed to the dramatic increase in power emergencies in the past year (**Figure 7**).

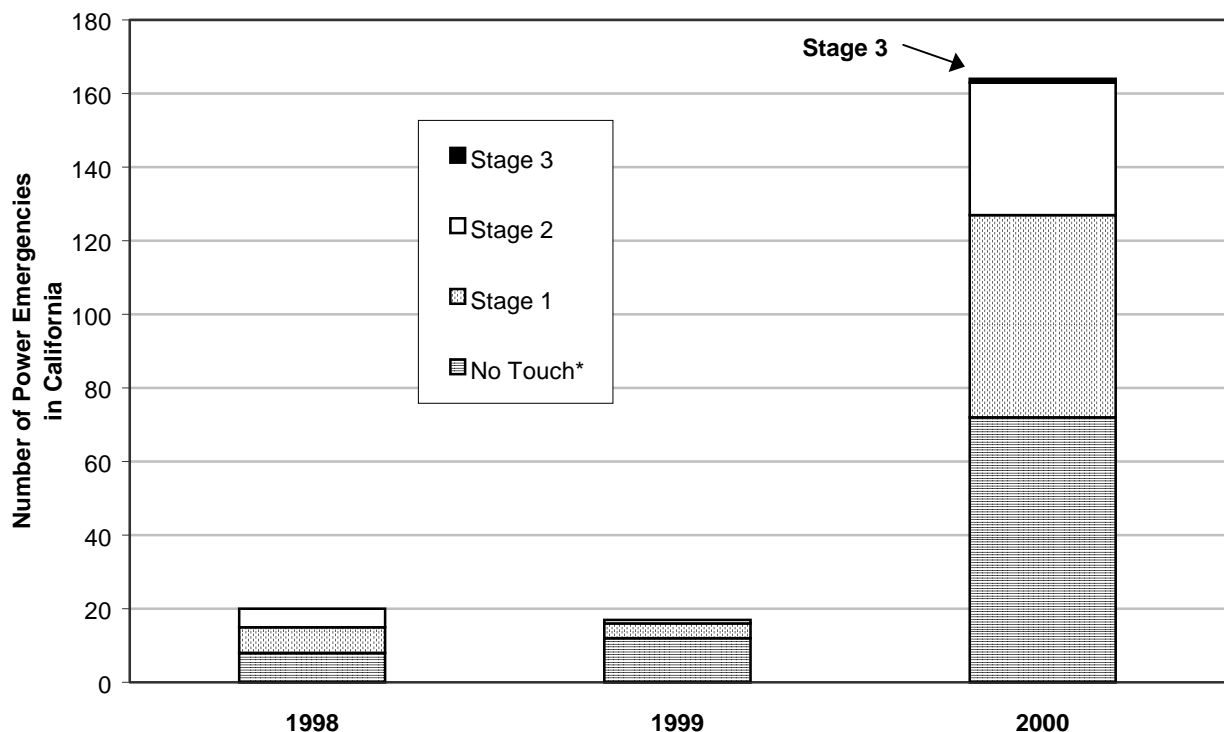


Figure 7. Sudden Increase in Declared Power Emergencies

Note: Definitions of Power Emergencies:

"No Touch" periods. The Independent System Operator (ISO) demands that generators refrain from downtime for maintenance.

Stage 1. The ISO determines that an operating reserve shortfall is unavoidable or forecast within two hours.

Stage 2. The ISO determines that the operating reserve will fall below 5 percent.

Stage 3. The ISO determines that the operating reserve will fall below 1.5 percent.

Source: California Independent System Operator Web site,

<<http://www.caiso.com>>.

The potential loss of reliability is further increased by natural disasters such as earthquakes and heavy storms. Finally, the power quality needed by high technology industries is compromised during periods of peak demand. It is estimated that \$3-6 billion are lost annually in California because of damages associated with inadequate power quality and reliability. In addition, it is estimated that the high technology industry alone in California will spend about \$4 billion annually by 2004 on backup and power-conditioning systems to meet its unique needs.

The PIER Program will address the problem of rising peak demand by funding RD&D aimed at:

- *Increasing local generation technology options* - PIER will fund technologies that will provide improved operational characteristics for renewable and advanced gas-fired generation in on-site and distributed generation applications. These activities will focus on technological advances that will decrease capital and operational costs, increase efficiency, reduce emissions to the environment, and support integration of distributed generation within the power grid.
- *Reducing and shifting peak demand to off-peak periods* - PIER will fund the development of storage and conversion technologies to use off-peak generating capacity to meet demands at peak periods, as well as the development of more efficient end-use technologies for areas of demand that are major contributors to peak loading, such as residential and commercial air conditioning and lighting. In addition, PIER will support the development of power conditioning technologies that allow the maintenance of power quality in critical industries. PIER will develop load management systems and technologies for real time metering and pricing to inform and motivate consumers to shift demand to off-peak periods.
- *Enhancing the performance of transmission and distribution systems* - PIER will fund programs that lead to enhanced power grid performance by reducing congestion and increasing reliability. These will include new numerical models, information systems, sensors, and software to bolster system operation and allow the integration of distributed generation systems

3. Balance is needed between energy needs and environmental protection

Life-cycle impacts of energy production and use account for one of the largest impacts on the environment. The need for and continual growth of electricity supply must be balanced with the need to protect and enhance the environment.

Decision-making tools to better predict such impacts and methods to ameliorate them are under-developed, particularly for cumulative impacts on ecosystems, air quality, and water quality. The unintended consequences of new technology in our energy mix, such as indoor air quality problems associated with older energy efficient buildings, need to be better understood. While environmental constraints can affect electricity supply, new applications of electricity in water treatment and other industries can improve the environment while saving energy. Finally, waste problems confronting agriculture and forestry management are only beginning to be addressed by the development of new energy technologies.

The PIER Program will address the problem of balance between energy and the environment by funding RD&D aimed at:

- *Improving the prediction, measurement, and mitigation strategies of environmental impacts from electricity systems* – PIER will accomplish this by developing a science base to evaluate potential environmental impacts and offer solutions to ameliorate those impacts. PIER will address the full range of impacts from all electricity-related activities, from generation, to the transmission and distribution, to end-use.
- *Developing electrical technologies that benefit the environment* – PIER will develop technologies that solve costly environmental problems while producing electricity in the process, such as biomass reactors for the processing of agricultural, dairy and forest waste. In addition, PIER will fund the development of new electricity end-use technologies and new control technologies that are substantially cleaner and more efficient than those replaced.

4. Market uncertainty and price volatility are impacting energy delivery and use

Market structure, rising fuel costs, high peak demand, and other factors produce market uncertainty and price volatility. Specific contributing factors include the following:

- Current market structures and rules that limit participation, add middlemen, and magnify price impacts associated with scarce supply (**Figure 8**),
- The decreased availability and consequent increased cost of natural gas,
- A 33 percent increased reliance on natural gas for fossil generation between 2000 and 2010,
- The rapid growth in peak demand outstripping the ability to serve that peak, and
- The high cost and limited availability of emission trading credits.

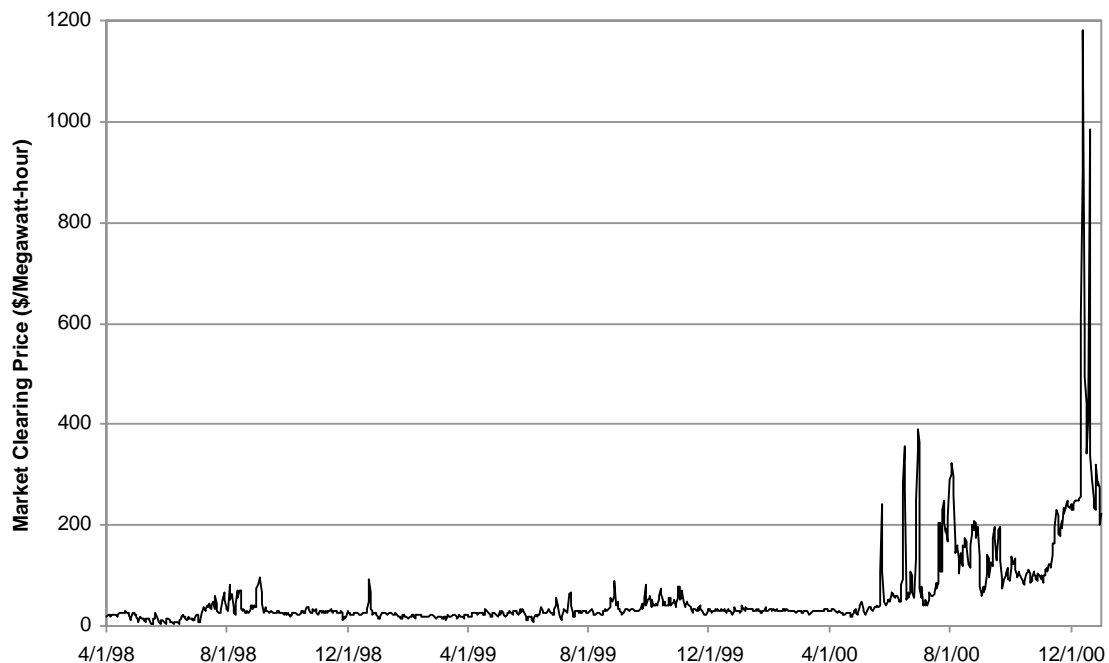


Figure 8. Daily Market Clearing Price for Electricity at the California Power Exchange

Source: "Unconstrained Market Clearing Prices and Quantities in PX Day-Ahead Market," University of California Energy Institute web site, http://www.ucei.berkeley.edu/ucei/datamine/px_umcp.html.

Economic and energy system models to better understand the new relationships embodied in the California electrical system are relatively undeveloped. The current system creates financial risks for suppliers and investors that could inhibit future construction of central facilities.

The PIER Program will address this problem by funding RD&D aimed at the following:

- *Improving the understanding of California's energy market structure and rules* - PIER will support the development of advanced knowledge of how energy markets work, identifying opportunities to improve operation of markets in California. This better understanding of market dynamics will provide valuable insight and advice for possible changes to rules and regulations to make the system more efficient, reduce risk, and allow more flexible, multi-disciplinary approaches in the system operation.
- *Addressing other energy problems* – Aspects of Problem 4 will also be addressed through the strategies described for Problems 1 and 2.

Five-Year Plan Implementation: Funding Allocations

The PIER Program will adopt a portfolio approach to effectively balance the risks, benefits to ratepayers, and time horizons for various PIER activities and investments. All PIER research priorities will be approved by the PIER Program Manager and the Commission's RD&D Committee based upon emerging opportunities, shifts in important electricity system problems, and the benefits derived from prior projects in each subject area. This will ensure that the PIER Program develops solicitations and funds projects that provide the most significant benefits to the citizens and ratepayers of California.

Funding will be allocated to the following:

1. Advance science and engineering for a diverse range of technologies

To support diverse technologies, PIER has Team Leads and support staff to manage and guide projects in the following technical subject areas:

- Buildings End-Use Energy Efficiency – higher-efficiency appliances, higher-efficiency air conditioning and lighting systems, improved building design tools and improved building operating procedures,
- Industrial/Agricultural/Water End-Use Energy Efficiency – improved energy storage and conversion systems, integration of energy storage with renewable systems, improved process efficiencies, advanced waste treatment and pollution mitigation technologies, improved pumping and water treatment technologies,
- Renewable Energy – integration of renewables technologies into building design, integration of renewables into industrial processes, integration of renewable generators into grid, improved affordability and reliability of renewables systems,
- Environmentally-Preferred Advanced Generation – reduction of the costs of small, advanced fossil-fueled electric generation technologies; integration of distributed generation systems into the electrical grid; determination of impacts on the grid of widespread adoption of distributed generation; development of improved distributed generation system controls to assure safety of utility workers,
- Energy-Related Environmental Research – determination of environmental impacts of distributed generators; improved models of cumulative impacts of energy systems; development of scientific basis for emissions trading across basins, across pollutants, and across time periods; provision of information to inform regulatory and policy decisions,
- Energy Systems (Strategic) Research – advances in transmission, distribution and storage; enabling technologies, such as advanced sensors and information systems; improved real-time measurement and control technologies to give customers better control over their electricity choices; better understanding of how energy markets work in a deregulated electricity system.

To facilitate planning, team leads will be allocated funding for a two-year period. The allocation will be based on how their objectives and metrics contribute to the overall program.

2. Address different time frames for impact on the market and different challenges along the RD&D spectrum

Maintaining and enhancing a balanced portfolio of technologies in various stages of development is critical because of the complexity of the problems facing California. RD&D activities will range from feasibility studies on new, longer-term energy concepts, to applied research, to technology development, to demonstrations. Some of the PIER Program's near-term projects could be commercialized and provide benefits by 2002 while many other successful projects will provide benefits over the course of the next decade. We will also fund some higher risk research that has the potential for significant breakthroughs in the long-term.

3. Fund integrated solutions for major energy problems

Integrated activities will have the potential to produce enhanced benefits through their synergies and coordination within the PIER Program and with other RD&D Programs. The PIER Program will seek to leverage its funds with co-funding or in-kind contributions from other private, regulated, or public sector participants. These efforts will be coordinated with market participants and other public goods programs to ensure that the results reach the market as quickly and efficiently as possible.

To reduce the risk that RD&D results will not reach the market and produce benefits, some PIER solicitations require a "programmatic" approach to solving problems. This means that bidders must propose a linked set of RD&D projects employing a mix of technologies that address a common barrier or seek a common goal. To accomplish this, bidders must use a team of expert participants who will work across organizational and institutional boundaries to implement complete solutions, including market entry.

The five-year investment budget for the PIER Program must balance the competing objectives of addressing the four major energy problems facing California, maintaining flexibility to respond to the unpredictable changes that are likely to occur, and adhering to the criteria described above. This will be done by (1) dedicating a minimum of \$165 million (approximately one-half of the funds available over the five years) to implementing the various strategies designed to address the four problems shown in **Table 1** below; and (2) reserving the remaining available funds (approximately \$147.5 million over five years) to be competitively allocated to specific activities and strategies based on their expected public interest benefits.

Table 1. PIER Program Budget For 2002 through 2006

Electricity Problems of Highest Concern in California	Five-Year Budget (\$ millions)
1. Electricity demand is increasing faster than supply.	\$50
2. Rising peak demand threatens reliability.	\$50
3. Balance is needed between electricity and the environment.	\$50
4. The market structure, fuel shortages, emission allowances and high peak demand produce market uncertainty and price volatility.	\$15
Dedicated five-year budget	\$165
Reserved five-year competitive budget	\$147.5
Total five-year budget @ \$62.5 million per year	\$312.5

Notes: 1) For the remainder of 2001, the PIER Program will continue to follow the existing PIER Strategic Plan with actual RD&D activities that are consistent with the comments received from both the Policy Advisory Council and the Independent Review Panel.

2) Initially, Problem #4 will be funded at a lower level than the other three problems because its strategies overlap those for Problems #1 and #2, and other strategies and activities to address this problem may be less amenable to RD&D solutions.

Funds will be allocated based on the roadmaps to be developed for each subject area and on overall program goals. These roadmaps will contain criteria for project selection and a set of metrics to gauge project and program impacts. The Program Manager will retain funds that will be allocated to subject areas as new opportunities are identified. This approach provides an appropriate mix of focus and flexibility for meeting program goals. The funding process must remain flexible as the relative importance of issues change. The reasons for flexibility include the following:

- Research and development efforts may shift funding from some areas to others that have greater potential for success.
- The emergence of new, unforeseen concerns. For example, PIER has not specifically addressed transmission and distribution issues under AB 1890. This is now an area of considerable importance.
- Increased funding by another institution or agency may allow us to re-allocate scarce resources.

- Successful commercialization of technologies will eliminate the need for further PIER funding in these areas.
- Periodic review to determine which areas should receive increased funding and to discover emerging research and technology ideas.

4. Fund technology partnerships to leverage PIER dollars

California possesses the intellectual and institutional resources to help meet the state's energy challenges. The PIER Program will foster closer ties with the University of California and California State University, the California Environmental Protection Agency, and the California Trade and Commerce Agency. Success requires that we develop and maintain effective and mutually rewarding relationships with industry—both technology users and providers—and institutions that commercialize technologies, such as business incubators, private industry and California utilities, generators and providers.

Further, the PIER Program will continue to develop and enhance technology partnerships with the U.S. Department of Energy, particularly with the Office of Energy Efficiency and Renewable Energy. We will focus on California-specific problems (and, if possible, frame the debate for overall program direction) with the Offices of Power Technology, Industrial Technology, and Buildings Technology. We plan to work with both the Office of Fossil Energy on selected projects and the Office of Science on selected areas of environmental research.

In addition, we intend to work closely on problems of mutual interest with national research organizations (e.g., the Electric Power Research Institute and the Gas Technology Institute) and other states and their energy research organizations (e.g., the New York State Energy Research and Development Authority).

To derive maximum benefits, PIER funding decisions will be made, in part, to selectively participate in collaborative activities with these groups, while avoiding duplicative efforts.

Addressing the Recommendations of the Independent Review Panel

Actions Taken To Date

Many of the leadership and management issues raised in March 2000 by the Independent Review Panel (IRP) have been resolved and their recommendations put into place. A Program Manager and Team Leads for all subject areas are now in place. Their roles and responsibilities, while still being fine-tuned, are reasonably well defined. The Program Manager has clear authority to make decisions. Team Leads are responsible for solicitations and awards, contract management, project integration, subject area planning, and budget development. The Program Manager relies upon them to assist in long-term strategic planning. Program support staff are responsible for contract streamlining, technology transfer, information management, budget development, and program evaluation and integration.

The record is also good for the IRP's second area of concern: policy and planning. The development of this PIER Five-Year Investment Plan focused on this effort. A vision has been developed, consistent with the PIER Program's mission and California's needs. The operational definition of public interest criteria has been clarified. Our work has better defined program context in terms of state problems and current state, federal, and private activities. We have clarified problem areas and developed a set of focused strategies to address them. While implementation remains a work in progress, PIER already funds programs consistent with our strategies. These will be further refined by developing roadmaps, which can be used for measuring success with pre-defined metrics.

Our record is more mixed in the third area of the IRP's recommendations concerning administrative issues. While some progress in contract reform has occurred, problems within the Commission remain. We are in the process of developing a more streamlined approach to contracting and Request for Proposal development. We are looking for ways to expedite the creation of agreements, including making greater use of grants and purchase orders and other available funding mechanisms as appropriate. Due to limitations on the Commission's procedures, external changes may also be necessary.

Staffing remains a major internal problem. The lack of staff has caused the PIER Program to fall behind schedule in project funding. Our inability to create new positions and the lack of opportunities for existing staff decreases our capacity to attract and retain high caliber staff. PIER will consolidate its operations within an independent division led by the Program Manager to allow better operational control with less reliance on matrixed staff. Some legislative relief may be necessary in both the administrative and staffing areas.

Innovative approaches are being used. PIER made use of the Interagency Jurisdictional Exchange mechanism to bring in the Program Manager and is exploring using it with the University of California to acquire new staff. We will also make greater use of technical support contractors, as well as obtaining broader support from key research and development contractors. We will also expand our use of technical advisory panels in all subject areas. The goal is to reach an intellectual and operational critical mass for the PIER Program, which it is currently lacking.

Future Expectations Based Upon the Independent Review Panel's Recommendations

Expectations and actions within the Commission include the following:

- Organizational responsibility and quality of research managers will continue to grow.
- The Program Manager will have sufficient authority to effectively lead the PIER Program, and sufficient flexibility to allocate RD&D funds in response to changing needs, opportunities and priorities.
- The Program Manager will develop a management roadmap incorporating timelines and metrics to quantify progress in meeting expectations.
- Contracts will be awarded in four months, on average.

Expectations and actions that require cooperation with external organizations include the following:

- PIER will be integrated into the other parts of the Public Goods Program, which will require developing more effective interaction with the California Public Utilities Commission.
- The Commission will request and receive legislative relief from staffing and contracting constraints as needed.
- The California Congressional delegation will be informed about federal funding needs and initiatives as they relate to California and PIER.
- The Commission and PIER will work with the Department of Energy to modify their program portfolio to better match California's needs.
- PIER will develop more effective partnerships with other research centers, such as the University of California, the Electric Power Research Institute, and the Gas Technology Institute.

Summary

The rapid growth in the California economy in recent years has strained the capability of the electricity generation and distribution systems in California to keep up with growing demand for electricity. There will be continual requirements for economic, reliable, and safe electricity. The importance of the four major electricity-related problems and solutions presented earlier in this document are heightened by the electricity crisis in which California finds itself today. Among the actions California can take to avoid such crises in the future, an investment in RD&D is the most appropriate response for improving the technical aspects of the electricity system, from generation, to delivery, to end-uses, to environmental balance.

The implementation of the PIER Program is balanced to provide benefits to electric customers. The PIER Program pursues not only moderate-risk RD&D to solve electricity problems, but also higher-risk RD&D with the potential for creating major paradigm shifts in the ways electricity is supplied and used. The PIER Program is designed to provide a continuous pipeline of solutions to near-term, mid-term, and long-term problems. Further, PIER RD&D has been planned to mesh with, but not duplicate, the RD&D being done by private, state, and federal entities to achieve maximum leverage of the California electric customers' dollars. Finally, the PIER Program will continually monitor electricity problems and needs in California and maintain the flexibility to respond to changing conditions.

Since its creation less than four years ago, the PIER Program has completed its transitional phase and is now slated to consolidate its operations within an independent division at the Commission. The PIER Program has taken many steps recommended by the Independent Review Panel to improve the efficiency and effectiveness of its operations, and the Program Manager will work with Commission management to recommend and implement appropriate changes in the future. Finally, PIER management will continue to strengthen cooperation with external organizations to our mutual benefit, and acquire additional staff so that the PIER Program can live up to its full potential.